

What is claimed is:

1. A high aspect ratio microcapsule comprising an antimicrobial agent coated with a hydrophilic polymer, said microcapsule having an aspect ratio of greater than about 2.

2. A high aspect ratio microcapsule according to claim 1 wherein the inorganic antimicrobial agent contains a metal or metal ion selected from the group consisting of silver, copper, zinc, tin, gold, mercury, lead, iron, cobalt, nickel, manganese, arsenic, antimony, bismuth, barium, cadmium, chromium, thallium and combinations thereof.

3. A high aspect ratio microcapsule according to claim 2 wherein the antimicrobial metal or metal ion is silver, zinc, copper or a combination of any two or all three of the foregoing.

4. A high aspect ratio microcapsule according to claim 1 wherein the antimicrobial agent is selected from the group consisting of metal salts, metal oxides, antimicrobial water soluble glasses, antimicrobial metal ion-exchange type agents and combinations thereof.

5. A high aspect ratio microcapsule according to claim 4 wherein the antimicrobial agent is an antimicrobial metal ion-exchange type agent comprising a ceramic carrier having ion-exchanged antimicrobial metal ions.

6. A high aspect ratio microcapsule according to claim 5 wherein the ceramic carrier is selected from the group consisting of zeolites, hydroxyapatites and zirconium phosphates.

7. A high aspect ratio microcapsule according to claim 6 wherein the antimicrobial agent is a zeolite that contains silver ions.

8. A high aspect ratio microcapsule according to claim 1 wherein the hydrophilic polymer is a polymer with water absorption at equilibrium of at least about 2% by weight.

5 9. A high aspect ratio microcapsule according to claim 8 wherein the hydrophilic polymer is a polymer with water absorption at equilibrium of at least about 5% by weight.

10 10. A high aspect ratio microcapsule according to claim 9 wherein the hydrophilic polymer is a polymer with water absorption at equilibrium of at least about 20% by weight.

15 11. A high aspect ratio microcapsule according to claim 10 wherein the hydrophilic polymer is chosen from polyhydroxyethyl methacrylate, polyacrylamide, N-vinyl-2-pyrrolidinone, polysaccharides, polylactic acid, polyamide and polyurethane.

12. A high aspect ratio microcapsule according to claim 11 wherein the hydrophilic polymer is polyurethane.

20 13. A high aspect ratio microcapsule according to claim 1 wherein the microcapsule contains from about 1 to about 1000 parts by weight of antimicrobial agent based upon 100 parts by weight of hydrophilic polymer.

25 14. A high aspect ratio microcapsule according to claim 13 wherein the microcapsule contains from about 10 to about 200 parts by weight of antimicrobial agent based upon 100 parts by weight of hydrophilic polymer.

30 15. A high aspect ratio microcapsule according to claim 14 wherein the microcapsule contains from about 20 to about 100 parts by weight of antimicrobial agent based upon 100 parts by weight of hydrophilic polymer.

16. A high aspect ratio microcapsule according to claim 1 further comprising an inorganic discoloration inhibiting agent.

17. A high aspect ratio microcapsule according to claim 16 wherein said discoloration inhibiting agent is an ammonium compound.

18. A high aspect ratio microcapsule according to claim 17 wherein the antimicrobial agent comprises an ion-exchange type antimicrobial agent and said inorganic discoloration agent comprises ion-exchanged ammonium ions contained within said antimicrobial agent.

19. A high aspect microcapsule according to claim 1 further comprising a dopant agent.

20. A high aspect ratio microcapsule according to claim 19 wherein said dopant is an inorganic sodium salt.

21. A microcapsule according to claim 20 wherein said dopant is sodium nitrate.

22. A high aspect ratio microcapsule according to claim 1 wherein the high aspect ratio microcapsule comprises multiple particles of one or more antimicrobial agents encapsulated within a hydrophilic polymer.

23. A method for manufacture of a high aspect ratio microcapsule comprising:
(a) compounding of the antimicrobial agent with the hydrophilic polymer
(b) fabricating the compounded product to the desired size and aspect ratio.

24. The method of manufacture of a high aspect microcapsule according to claim 23 wherein the antimicrobial agent is a zeolite containing silver.

25. A method for manufacture of a high aspect ratio microcapsule according to claim 23 wherein the compounding is done by a method selected from the group of extrusion, pultrusion, RIM and powder coating.

5 26. A method for manufacture of a high aspect ratio microcapsule according to claim 25 wherein the compounding and fabrication is done by extrusion into fibers and chopping the fibers to the desired length.

10 27. A method for manufacture of a high aspect ratio microcapsule according to claim 23 wherein the fabrication is done by flaking.

15 28. A method for manufacture of a high aspect ratio microcapsule according to claim 23 wherein the fabrication is done by preparation of a film and chopping the film to the desired size.

29. A method for manufacture of a high aspect ratio microcapsule according to claim 23 wherein the fabrication is done to give high aspect ratio microcapsules wherein the average longest dimension is less than about 3000 microns.

20 30. A method for manufacture of a high aspect ratio microcapsule according to claim 29 wherein the fabrication is done to give high aspect ratio microcapsules wherein the average longest dimension is from about 5 microns to about 1000 microns.

25 31. A method for manufacture of a high aspect ratio microcapsule according to claim 30 wherein the fabrication is done to give high aspect ratio microcapsules wherein the average longest dimension is from about 10 microns to about 500 microns.

30 32. A method for manufacture of a high aspect ratio microcapsule according to claim 31 wherein the fabrication is done to give high aspect ratio microcapsules wherein the average longest dimension is from about 20 microns to about 100 microns.

33. A high aspect ratio microcapsule according to claim 1 wherein the aspect ratio is from about 4 to about 100.

34. A high aspect ratio microcapsule according to claim 33 wherein the aspect ratio is from about 5 to about 30.

35. A polymer composition comprising the high aspect ratio microcapsule of claim 1 and a matrix polymer wherein the high aspect ratio microcapsule comprises a discrete phase within the matrix polymer.

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36. The polymer composition of claim 35 wherein the matrix polymer is an addition polymer selected from the group consisting of polypropylene, polyethylene, polystyrene, polyvinylchloride, ABS, SAN, epoxy resins and polytetrafluoroethylene,

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37. The polymer composition of claim 35 wherein the matrix polymer is a condensation polymer selected from the group consisting of polyesters, polycarbonates, polyurethanes, polyimides, polyamides and silicone polymers.

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38. The polymer composition of claim 35 wherein the matrix polymer is not a hydrophilic polymer.

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39. The polymer composition of claim 35 wherein the matrix polymer is a hydrophilic polymer whose hydrophilic property is different from that of the hydrophilic polymer encapsulant used to make the high aspect ratio microcapsule.

40. The polymer composition of claim 35 wherein the matrix polymer is a copolymer.

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41. The polymer composition of claim 35 wherein the matrix polymer is a polymer blend.

42. A method of preparing an antimicrobial resin comprising incorporating a high aspect ratio antimicrobial microcapsule according to claim 1 into a polymer matrix wherein the polymer matrix is not the same polymer as used to form the high aspect ratio microcapsule.

43. The method of claim 42 wherein the high aspect ratio microcapsule is melt blended with the polymer matrix material.

44. The method of claim 42 wherein the high aspect ratio microcapsule is dry blended with a second polymer in powder form and powder coated onto a substrate.

45. A method of controlling the rate of release of an antimicrobial agent from a polymer matrix comprising forming a high aspect ratio microcapsule comprising an antimicrobial agent encapsulated within a hydrophilic polymer of a given hydrophilic property which allows for the release of the antimicrobial agent at a given rate and incorporating the high aspect ratio antimicrobial microcapsule into another polymer which is either non-hydrophilic or which has a different hydrophilic property.

46. A method of improving the antimicrobial properties of a non-hydrophilic polymer using a given amount of an antimicrobial agent comprising forming a high aspect ratio microcapsule comprising the antimicrobial agent encapsulated within a hydrophilic polymer and incorporating the antimicrobial microcapsule into the non-hydrophilic polymer to form an antimicrobial composition having improved antimicrobial performance as compared to a similar composition wherein the antimicrobial agent is directly incorporated into the non-hydrophilic polymer.